Prospective, randomized comparison of Modified Raj and Coracoid approach for Infra clavicular block using Nerve locator in randomly selected adult surgical patients.

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IN

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BRANCH X

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MADRAS MEDICAL COLLEGE

CERTIFICATE

This is to certify that the dissertation entitled, "**Prospective, Randomized comparison of Modified Raj and Coracoid approach for Infra clavicular block using Nerve locator in randomly selected adult surgical patients**". SUBMITTED BY **Dr. SRI VIKRAM PRABU.S** in partial fulfilment for the award of the degree of **Doctor of Medicine in Anaesthesiology** by the Tamilnadu Dr.M.G.R. Medical University, Chennai is a bonafide record of the work done by him in the Department of Anaesthesiology, Madras Medical College, during the academic year 2007 -2010.

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CONTENTS

INTRODUCTION

Peripheral nerve block, as apart of regional anaesthesia, is unique on its own features. Here the peripheral nerve conduction is blocked in a reversible manner using local anaesthetic. A single region of body is made insensitive to pain and is devoid of reflux response to surgical stimulus.

Advantage of Regional over General anaesthesia:

1. Least disturbance to normal physiology.
2. Safe in high risk patients where general anaesthesia cause more risk.
3. Only method, which prevents all afferent impulse from site of surgery from reaching CNS.
4. No poly pharmacy.
5. Vasodilatation caused improves circulation.
6. Adequate Post Operative pain relief.
7. Cost effective and safer.
8. No theatre pollution.
9. Safe in full stomach.
10. Airway manipulation avoided.

Regional anaesthesia traces its origin to Dr.Carl Koller, a young Viennese Ophthalmologist, who in 1884 employed a solution of cocaine for topical corneal anaesthesia in patients undergoing eye surgeries. Brachial Plexus block was first performed by William Stewart Halsted in 1889. He directly exposed the brachial plexus in the neck to perform the block and used cocaine.1n 1911,Hirschel first described the percutaneous approach to the brachial plexus. Kulenkampff first described the classical supra clavicular approach to the brachial plexus. The subclavian perivascular block was first described by Winnie and Collins.

INFRACLAVICULAR BLOCK…

In 1914 , Bazy described injecting below the clavicle, medial to the coracoid process along a line connecting with chassaignac's tubercle . Babitzky proposed an entry site where clavicle and second rib intersect and Balog suggested actually impinging the second rib.

Raj is credited with reintroducing the approach in 1973, the initial entry point at the mid point of the clavicle and directed the needle laterally toward the axilla using a nerve stimulator. Sims, in 1977, suggested a modification by moving the insertion point in the groove between the Coracoid process and the clavicle.

Whiffler, in 1981, first to describe the Coracoid infra clavicular block, little modified by Wilson in 1998. The block described by Raj underwent many modification , important ones are by Kaalstad et al in 1999 and Borgeat et al in 2001.

Advantages of Infra clavicular block :

1. Complete anaesthesia of the arm is obtained from the lower arm to the hand.
2. Tourniquet is well tolerated.
3. No need to abduct the arm to perform the block.
4. No need for separate injection for musculocutaneous or intercostobrachial nerve – an advantage over axillary block.
5. Bilateral block can be carried out without fear of blocking the phrenic nerve.
6. Least chance of pneumothorax.
7. Ideal for continuous catheter fixation and long term infusion.

In this study, the two popular approaches of Infra clavicular block are compared

1) **Modified Raj approach – Borgeat et al**

2) **Coracoid approach – Wilson et al**

AIM OF THE STUDY

Prospective, Randomized comparison of Modified Raj and Coracoid approach for Infra clavicular block using Nerve locator in randomly selected adult surgical patients posted for elective and emergency upper limb surgeries.

Primary Outcome Measures:

- Intensity
- Duration
- Efficacy

of the Infra clavicular block using the two approaches .

Secondary Outcome Measures:

- Time taken to perform the block
- Complication encountered
- Post operative analgesia

CLINICAL ANATOMY [1-3]

Brachial Plexus is one of the most commonly used peripheral nerve blocks in clinical practice. So knowledge of the formation of the brachial plexus and of its distribution is absolutely essential for the effective use of brachial plexus block for surgeries of the upper limb.

The Brachial plexus is formed by the ventral rami of the fifth to eighth cervical nerves and the greater part of the ramus of the first thoracic nerve. Additionally, small contributions may be made by the fourth cervical and second thoracic nerves. . Occasionally the plexus is mainly derived from C_4-C_8 (prefixed plexus) or from C_6-T_2 (post fixed plexus).

During organogenesis, between the 4th and the 8th week of development, the brachial plexus has a cone shape in the bud limb. The cutaneous innervation is distributed at the periphery of the trunk wall. As the bud limb grows, dermatome stretches out.

The cone then divides longitudinally into two independent planes, anterior and posterior, with the appearance of three cords. The posterior cord (posterior plane) provides innervation to the extensor and supinator muscles while the anterior plane, more

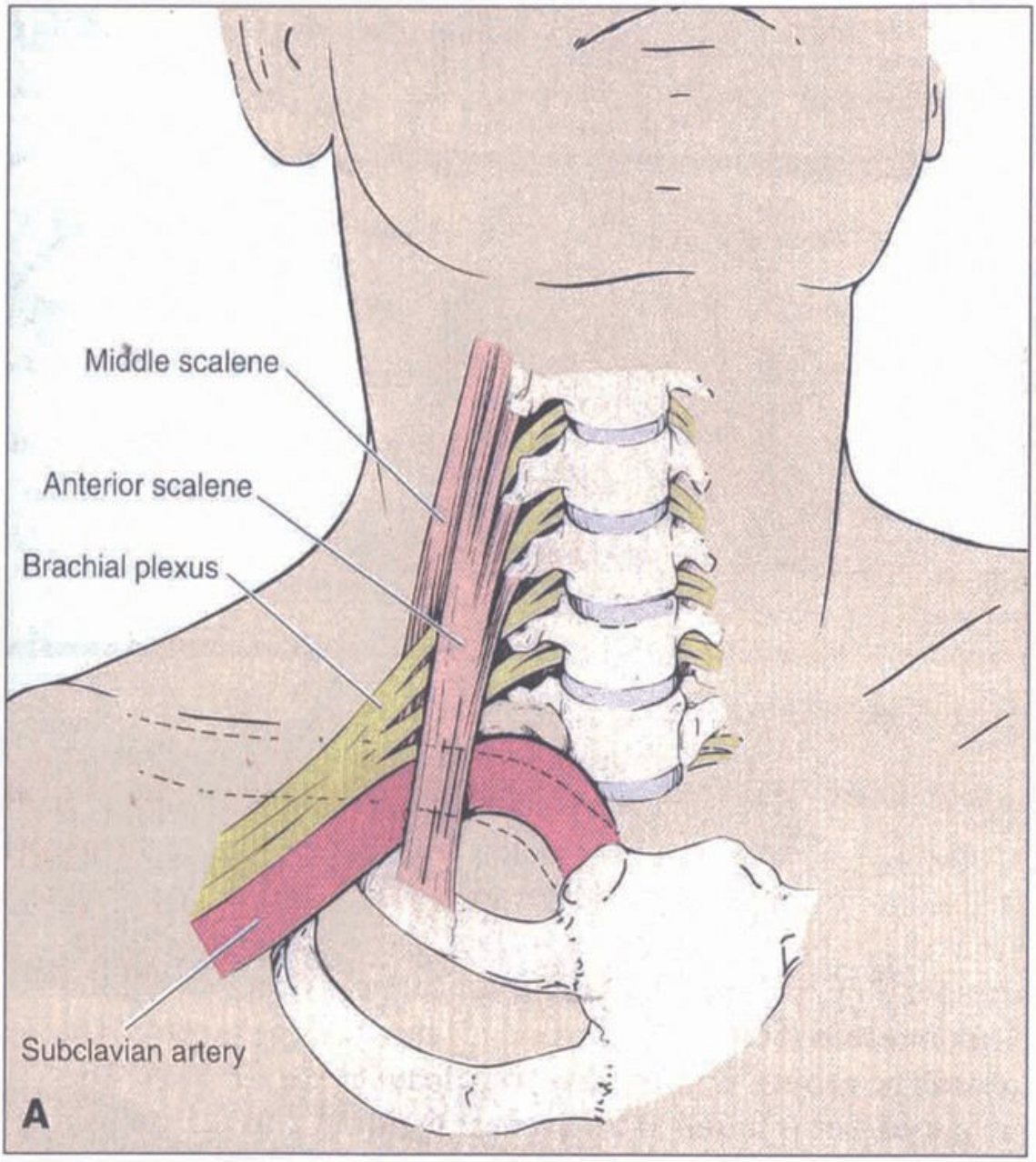
complex and variable, provides the medial and lateral cords that innervate the flexor and pronator muscles.

After the roots pass between the scalene muscles, they reorganize into trunks: superior, middle and inferior. Here the roots of C_5 and C_6 unite into the upper trunk, the root of C_7 continues as the middle trunk and those of C_8 and T_1 into the lower trunk. The trunks continue toward the first rib.

At the lateral edge of the first rib, these trunks undergo a primary anatomic division, into ventral and dorsal divisions. This anatomic division is significant because nerves destined to supply the originally ventral part of the upper extremity separate from those that supply the dorsal part.

As these divisions enter the axilla , the divisions give way to cords. The posterior divisions of all three trunks unite to form the posterior cord; the anterior divisions of the superior and middle trunks form the lateral cord; and the medial cord is the non united anterior division of the inferior trunk.

These cords are named according to their relation to the second part of the axillary artery. At the lateral border of the pectoralis minor muscle (which inserts onto the coracoid process), the three cords reorganize to give rise to the peripheral nerves of the upper extremity.


Middle scalene
Anterior scalene
Brachial plexus
Subclavian artery
A

The composition of brachial plexus can be summarized as follows:

1. Five roots (between the scalene muscles) the anterior primary rami of C_5-C_8 and T_1.

2. Three trunks (in the posterior triangle)

   a) Upper trunk C_5 and C_6

   b) Middle trunk C_7 alone

   c) Lower trunk C_8 and T_1

3. Six divisions (behind the Clavicle)

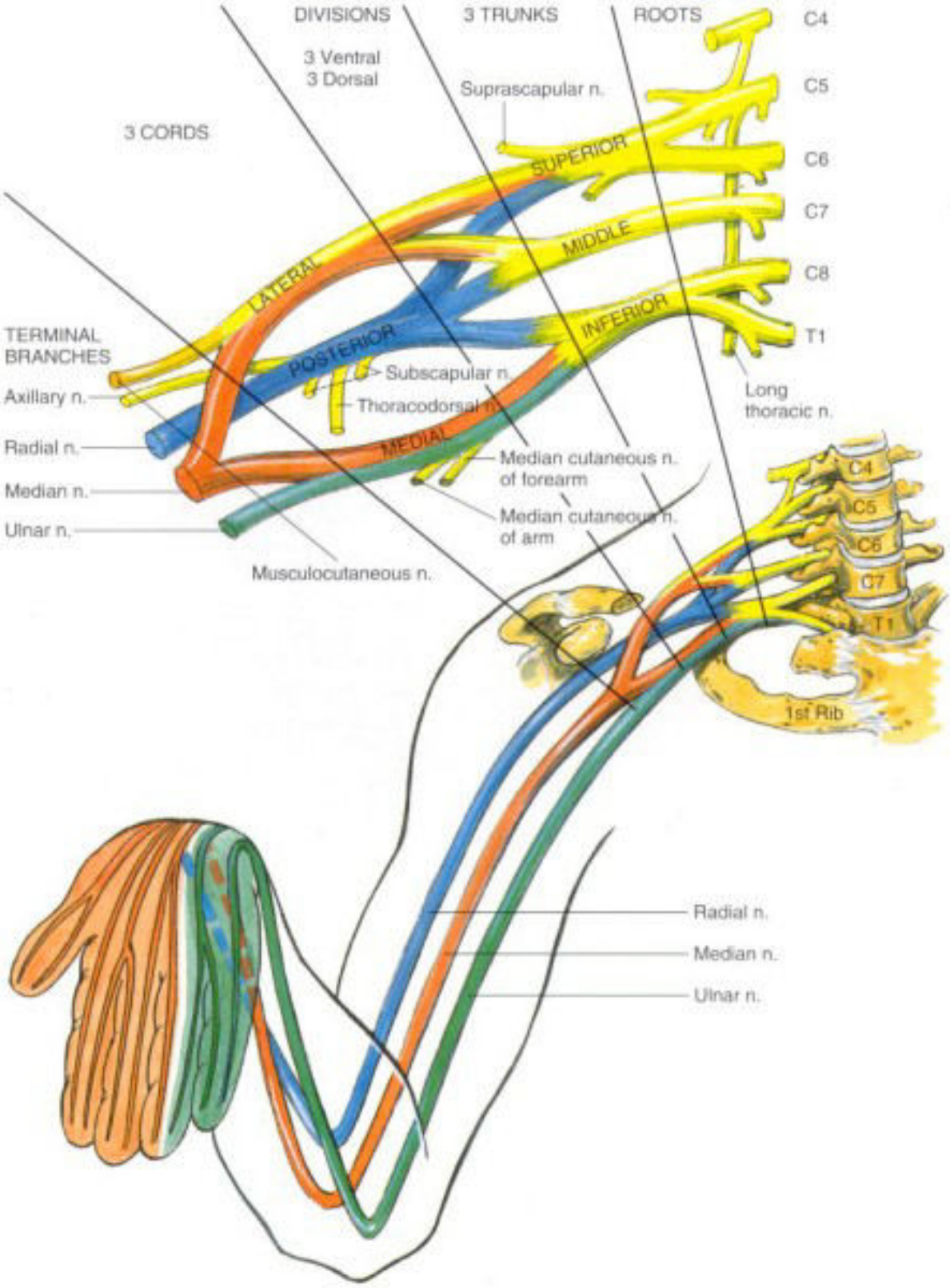
   Each trunk divides into an anterior and posterior division.

4. Three cords (within the axilla)

   a) Lateral Cord - the fused anterior divisions of the upper and middle trunks C_5 - C_7

   b) Medial Cord - the anterior division of the lower trunk C_8 - T_1

   c) Posterior Cord formed by the union of the posterior divisions of all three trunks C_5-T_1


DIVISIONS
3 TRUNKS
ROOTS
3 Ventral
3 Dorsal
3 CORDS
Suprascapular n.
SUPERIOR
MIDDLE
INFERIOR
LATERAL
POSTERIOR
MEDIAL
C4
C5
C6
C7
C8
T1
TERMINAL
BRANCHES
Axillary n.
Radial n.
Median n.
Ulnar n.
Musculocutaneous n.
Subscapular n.
Thoracodorsal n.
Median cutaneous n.
of forearm
Median cutaneous n.
of arm
Long
thoracic n.
1st Rib
Radial n.
Median n.
Ulnar n.

BRANCHES*:*

Branches are given off from roots, trunks and cords.

1. Branches from the roots:

   a) Nerve to the serratus anterior C_5, C_6 and C_7

   b) Muscular branches to

      - Longus cervices C_5 - C_8

      - Three Scalene C_5 - C_8

      - Rhomboids C_5

   c) Twig to the Phrenic nerve C_5

2. Branches from the trunks:

   a) Suprascapular nerve C_5-C_6

   b) Nerve to subclavius C_5-C_6

3. Branches from the Cords:

   a) Lateral Cord

- Lateral Pectoral nerve C_5-C_7

- Lateral head of median nerve C_5-C_7

- Musculocutaneous nerve C_5-C_7

b) Medial Cord

- Medial Pectoral nerve C_8 - T_1

- Medial head of median nerve C_8 - T_1

- Medial Cutaneous nerve of arm C_8 - T_1

- Medial Cutaneous nerve of forearm C8 - T1

- Ulnar nerve of arm C7, C8 - T1

c) Posterior Cord

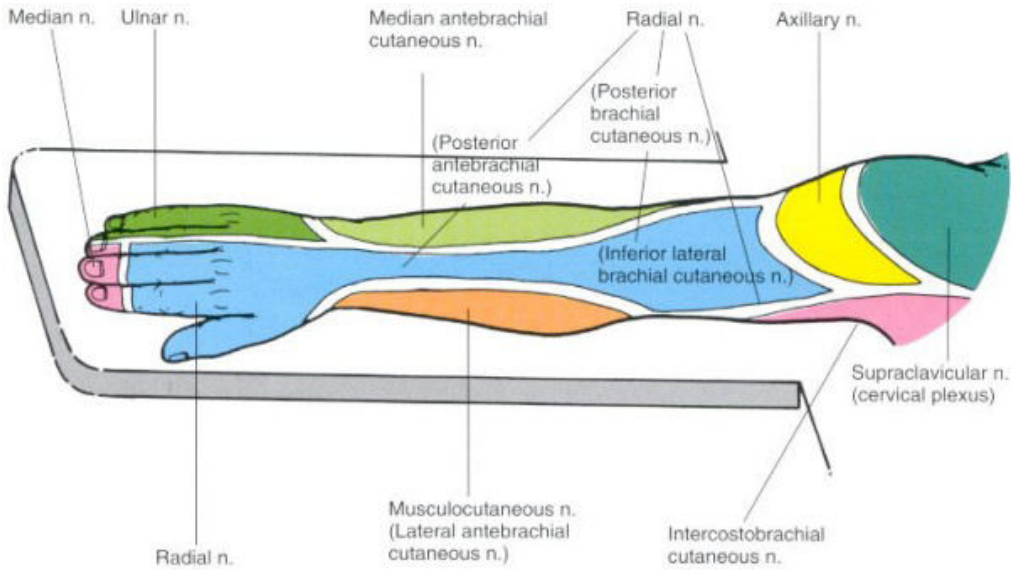
- Upper Subscapular nerve C_5-C_6

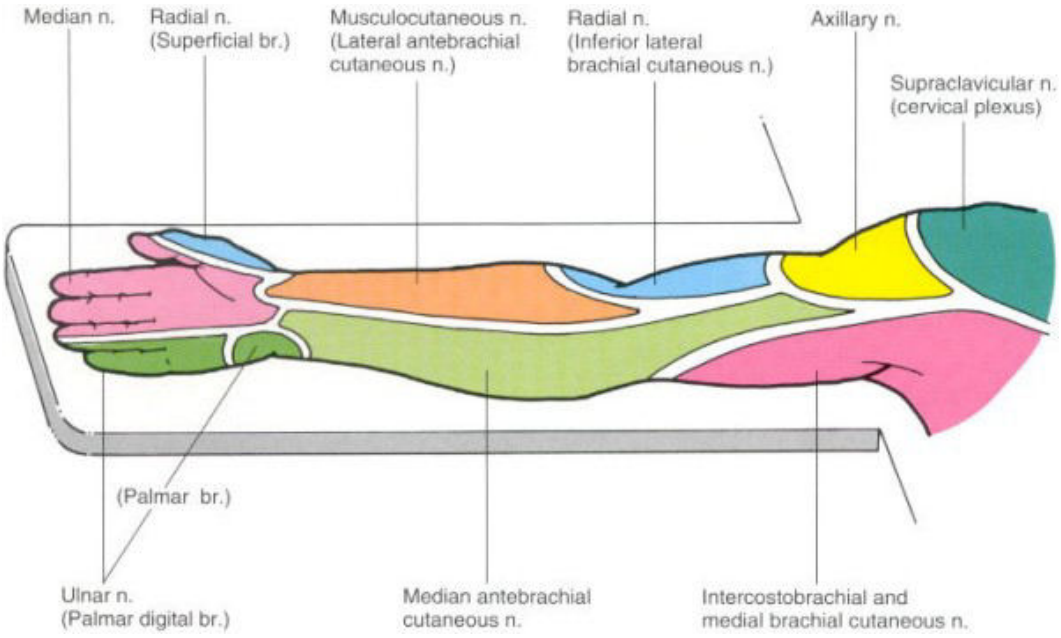
- Lower Subscapular nerve C_5-C_6

- Nerve to latissimus dorsi C_6, C_7, C_8

- Axillary nerve C_5-C_6

- Radial nerve C_5, C_6, C_7, C_8, T_1





As the brachial plexus nerve roots leave the transverse processes, they do so between prevertebral fascia that divides to invest both the anterior and the middle scalene muscles. This prevertebral fascia surrounding the brachial plexus is thought to be in tubular form throughout its course, thereby allowing needle placement within the "sheath" to produce brachial plexus block easily.

However, the fascial covering is apparently discontinuous, with septa subdividing portions of the sheath into compartments that clinically may prevent adequate spread of local anesthetics. The discontinuity of the "sheath" increases as one moves from transverse process to axilla.

Another anatomic detail that requires highlighting is the proximal axillary anatomy at a parasagittal section through the coracoid process. At this transition site, the brachial plexus is changing from the brachial plexus cords to the peripheral nerves as it surrounds the subclavian and axillary arteries . At the site of this parasagittal section the borders of the proximal axilla are formed by the following anatomic structures.

Anterior: posterior border of the pectoralis minor muscle and brachial head of the biceps

Posterior: scapula and subscapularis, latissimus dorsi, and teres major muscles

Medial: lateral aspect of the chest wall including the ribs and intercostal and serratus anterior muscles

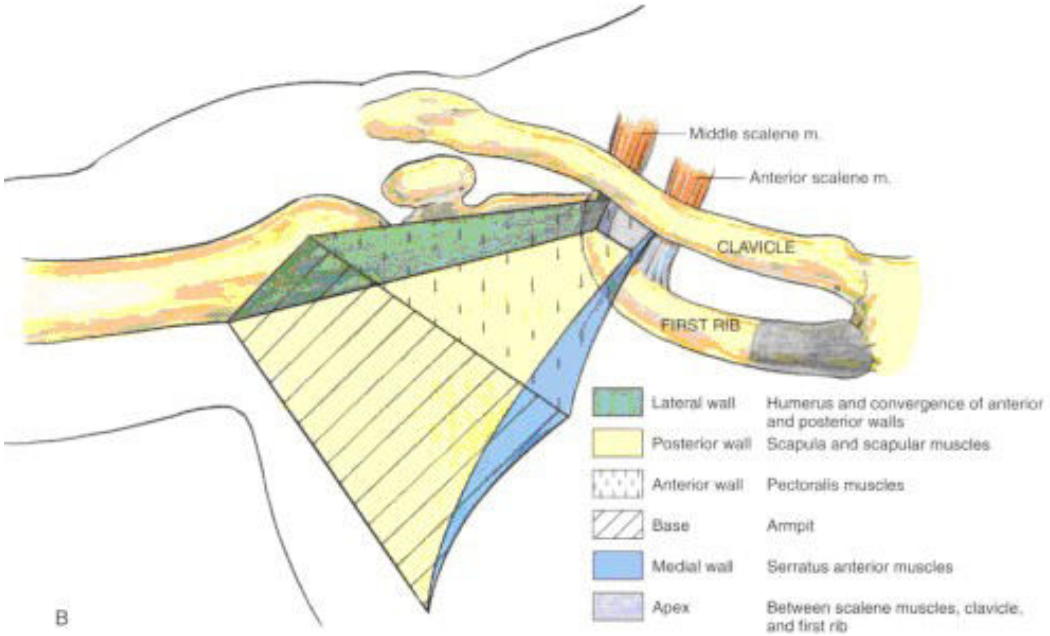
Lateral: medial aspect of upper arm

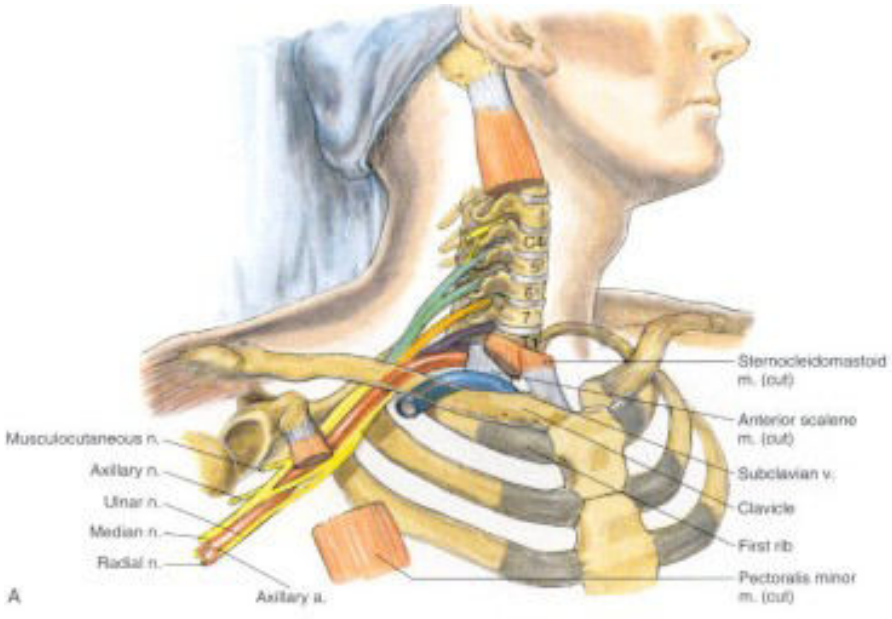
ANATOMY RELEVANT TO INFRACLAVICULAR BLOCK

At the level of the proximal axilla, where infraclavicular block is performed, the axilla is a pyramid-shaped space, with an apex, a base, and four sides . The base is the concave armpit, and the anterior wall is composed of the pectoralis major and minor muscles and their accompanying fasciae.

The posterior wall of the axilla is formed by the scapula and the scapular musculature - the subscapularis and the teres major. The latissimus dorsi muscle abuts the teres major to form the inferior aspect of the posterior wall of the axilla .

The medial wall of the axilla is composed of the serratus anterior muscle and its fascia, and the lateral wall is formed by the converging muscle and tendons of the anterior and posterior walls as they insert into the humerus .

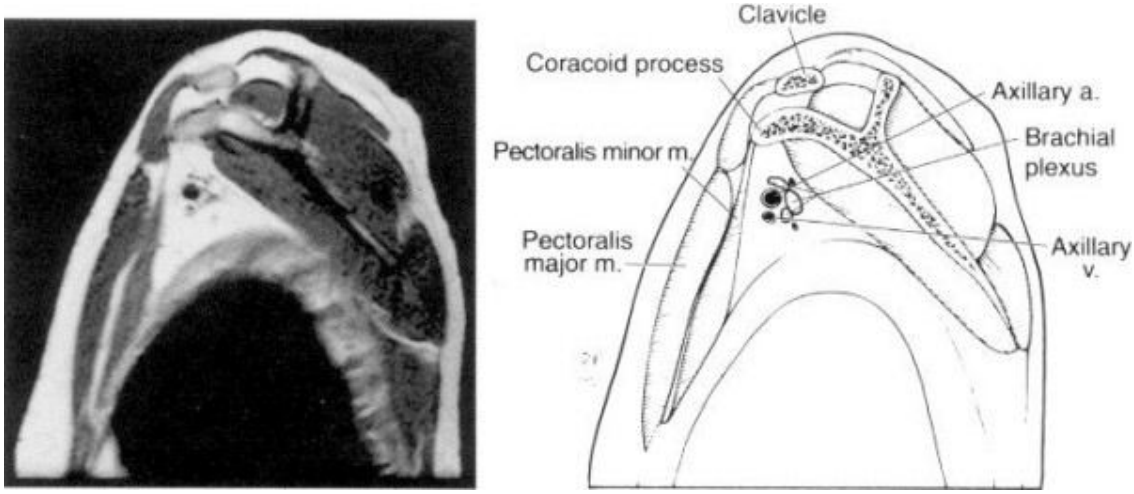

Middle scalene m.
Anterior scalene m.
CLAVICLE
FIRST RIB
Lateral wall
Humerus and convergence of anterior and posterior walls
Posterior wall
Scapula and scapular muscles
Anterior wall
Pectoralis muscles
Base
Armpit
Medial wall
Serratus anterior muscles
Apex
Between scalene muscles, clavicle, and first rib
B

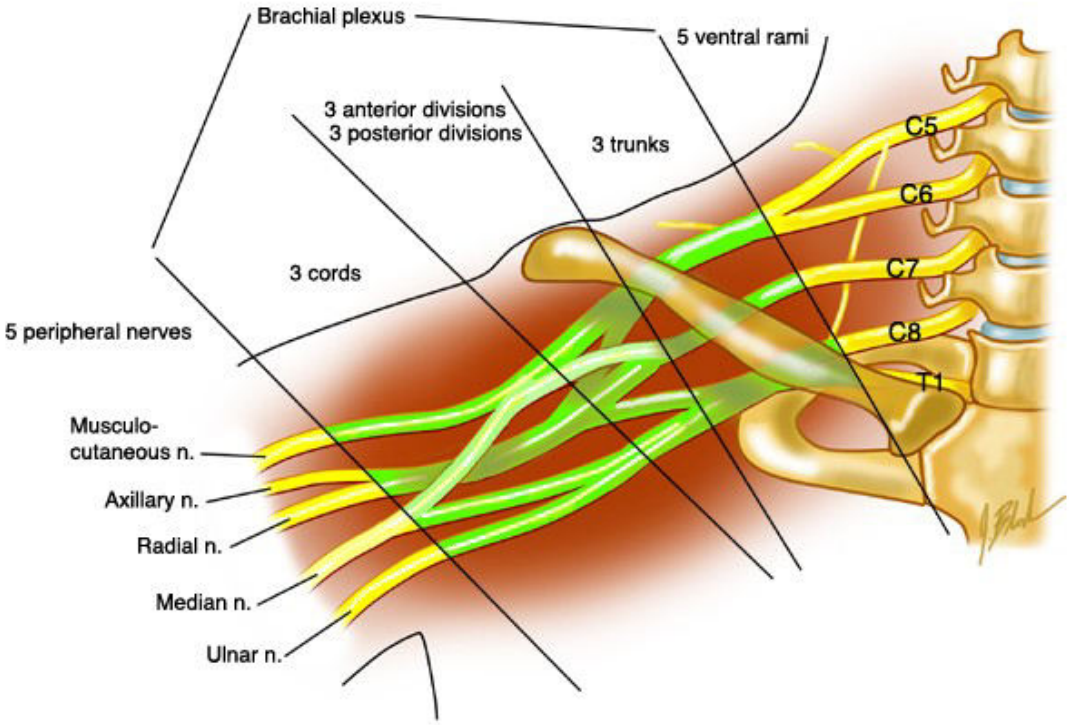

Musculocutaneous n.
Axillary n.
Ulnar n.
Median n.
Radial n.
Axillary a.
Sternocleidomastoid m. (cut)
Anterior scalene m. (cut)
Subclavian v.
Clavicle
First rib
Pectoralis minor m. (cut)
A

The apex of the axilla is triangular and is formed by the convergence of the clavicle, scapula, and first rib. The neurovascular structures of the limb pass into the pyramid-shaped axilla through its apex.The contents of the axilla are blood vessels and nerves —the axillary artery and vein and the brachial plexus— and lymph nodes and loose areolar tissue.

The neurovascular elements are enclosed within the anatomically variable, multipartitioned axillary sheath, a fascial extension of the prevertebral layer of cervical fascia covering the scalene muscles. The axillary sheath adheres to the clavipectoral fascia behind the pectoralis minor muscle and continues along the neurovascular structures until it enters the medial intramuscular septum of the arm.

The brachial plexus divisions become cords as they enter the axilla.These cords are named according to their relation to the second part of the axillary artery . Nerves to the subscapularis, pectoralis major & minor, and latissimus dorsi muscles leave the brachial plexus from these cords, as do the medial brachial cutaneous, medial antebrachial cutaneous, and axillary nerves. At the lateral border of the pectoralis minor muscle (which inserts onto the coracoid process), the three cords reorganize to give rise to the peripheral nerves of the upper extremity.


Clavicle
Coracoid process
Axillary a.
Brachial plexus
Pectoralis minor m.
Pectoralis major m.
Axillary v.


Brachial plexus
5 ventral rami
3 anterior divisions
3 posterior divisions
3 trunks
3 cords
5 peripheral nerves
C5
C6
C7
C8
T1
Musculo-cutaneous n.
Axillary n.
Radial n.
Median n.
Ulnar n.

TECHNIQUES OF INFRACLAVICULAR BLOCK [2,3&14]

Surgical anaesthesia of the upper extremity and shoulder can be achieved following neural blockade of the brachial plexus at various sites. The various approaches that can be used for this blockade is as follows:

- Interscalene approach
- Supraclavicular approach
- Infraclavicular approach
- Axillary approach

INFRACLAVICULAR BLOCK

Infraclavicular brachial plexus block is often used for patients requiring prolonged brachial plexus analgesia, and it is increasingly used for surgical anaesthesia by modifying it into a single-injection technique. Anaesthesia or analgesia with this technique results in a “high” axillary block.

Thus, it is most useful for patients undergoing procedures on the elbow, forearm, or hand. Like the axillary block, this technique is carried

out distant from both the neuraxial structures and the lung, minimizing complications associated with those areas. It also has advantages over axillary block in that this block may be perfomed with patient's arm in any position.

The Infra clavicular block was developed to avoid the side effects and complications of Supra clavicular block, particularly pneumothorax.. It provides a more consistent block of the axillary and musculocutaneous nerves than the axillary block .

There are many approaches described for Infra clavicular block .

Needle insertion sites :

1. **Raj et al** - 2.5 cm below mid – clavicle , needle 45 degree to skin directed to brachial artery .

2. **Borgeat et al** – mid distance from jugular notch to ventral acromial process , 1 cm caudal , needle 45 degree directed to axillary artery.

3. **Rodriguez et al** – 1.5 cm caudal and 1 cm medial to the coracoid process , needle perpendicular.

4. **Whiffler et al** – needle perpendicular at a point medial and caudal to the coracoid process ,a line from subclavian artery to the axillary artery.

5. **Wilson et al** – 2 cm caudal and medial to the coracoid process , needle perpendicular.

6. **Kapral et al** – 2 – 3 cm caudal to coracoid process , needle perpendicular.

7. **Koscielniak – Nielson et al** – 2 – 3 cm caudal to the coracoid process.

8. **Mehrkens - Kilka et al** – Just under the mid –clavicle , needle perpendicular.

9. **Salazar et al** – junction lateral 1/3 & medial 2/3 of the clavicle , one finger breadth below this point and medial to the coracoid , needle directed caudal , posterior and medial .

Commonly used approaches are discussed in detail

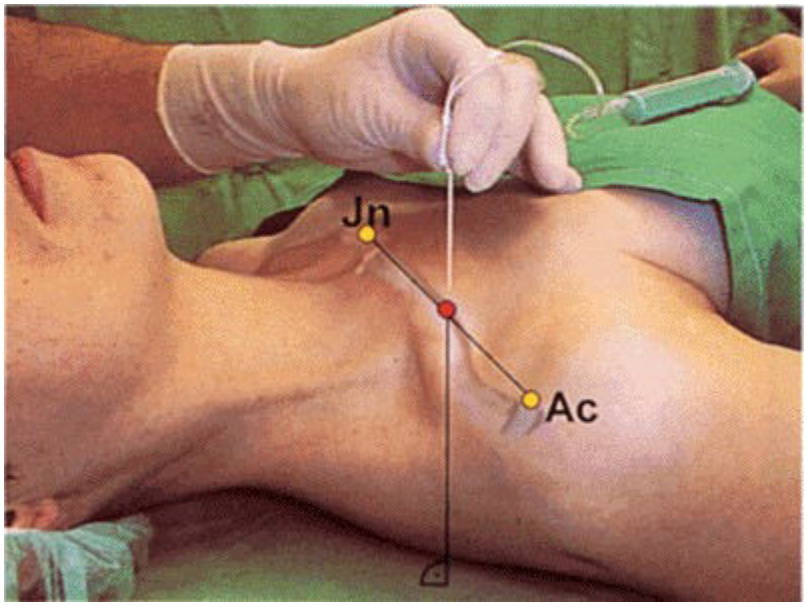
CLASSIC APPROACH – Vertical InfraClavicular Block

Patient Position: Supine, with the hand of the side to be blocked positioned in a relaxed manner on the abdomen, and the head slightly turned to the contralateral side.

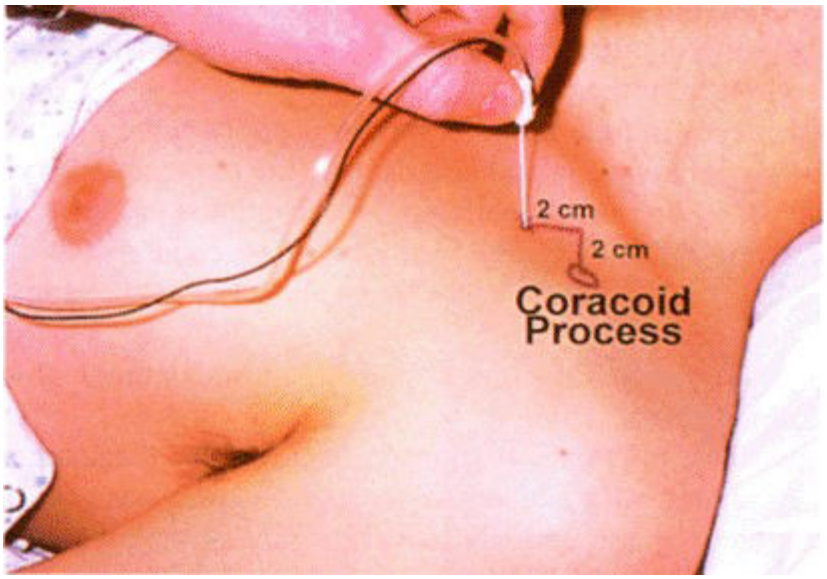
Anatomic Landmarks: The brachial plexus crosses beneath the clavicle in the vicinity of the middle of the clavicular line drawn between the halfway point of the ventral apophysis of the acromion and the jugular notch. In dissected cadavers, the plexus lay at a maximum depth of 4 cm lateral to the axillary artery and vein, where its three cords always converge at the entrance to the trigonum of the clavipectoral fascia.

Approach and Technique: The ventral apophysis of the acromion and the jugular notch is identified and the line joining these two points is drawn. The middle of this line determines the site of introduction of the needle. The insulated needle connected to a nerve stimulator is introduced directly beneath the clavicle and in a strictly vertical direction until appropriate response obtained .

Vertical Infraclavicular Block



Coracoid Approach



CORACOID APPROACH

Position & Landmark : Supine, arm resting at patient's side with the palm up. The coracoid process of the scapula is the sole anatomic landmark

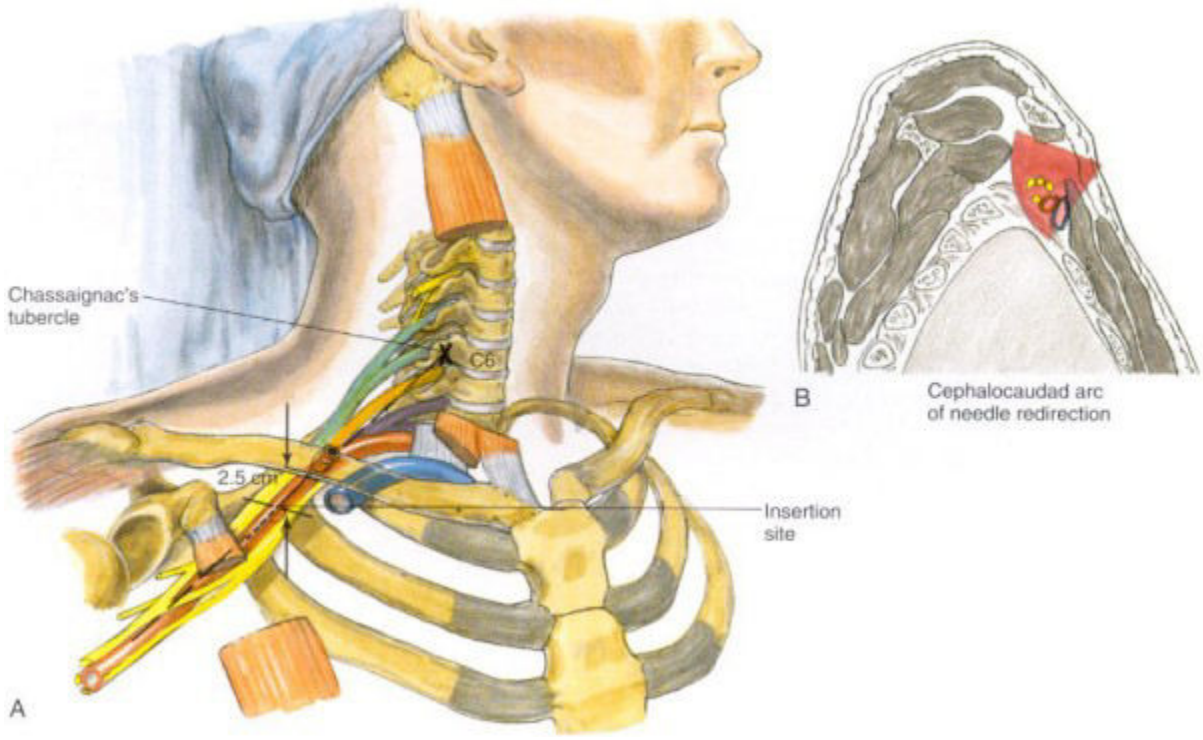
.

Approach and Technique:. From the center of the coracoid process, a point that is exactly 2 cm medial and 2 cm caudad is marked . This represents the site of introduction of the needle. The needle connected to a nerve stimulator is then inserted perpendicular to the table and advanced directly posterior until appropriate stimulation of the brachial plexus obtained.

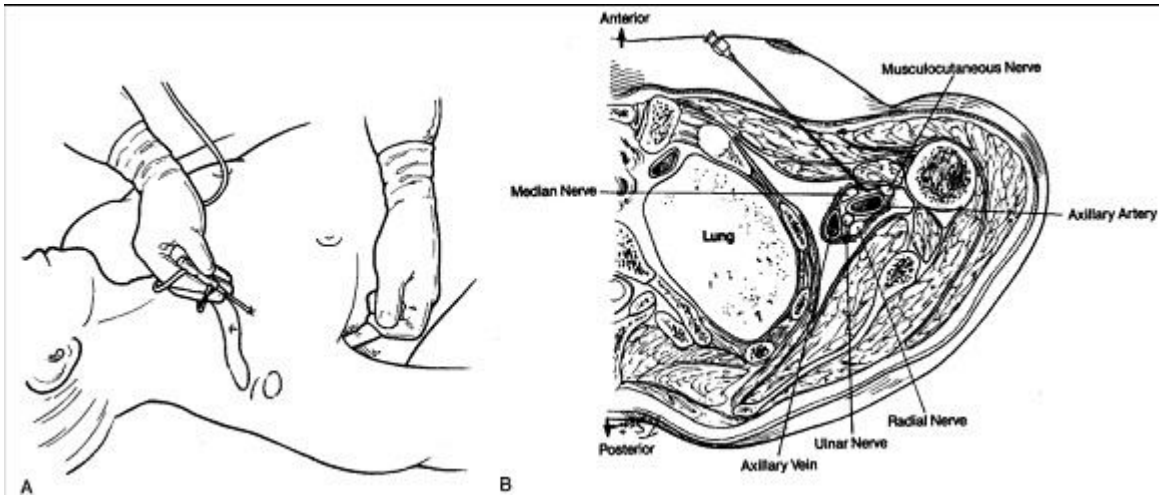
MODIFIED RAJ APPROACH

Position : Patient lies supine with the head turned away from the arm to be anesthetized , the arm being abducted to 90° and elevated by approximately 30°

Landmark : A point bisecting a line joining the ventral acromial process of the scapula (lateral landmark) and the jugular notch (medial landmark) is marked . The whole length of clavicle marked by palpation . The point of emergence of axillary artery at the fossa axillaries is next identified .



Raj Approach



Technique : A skin wheal raised 1 cm below the inferior border of the clavicle at its central point . The needle with nerve stimulator connected is directed laterally at between 45° and 60° to the skin toward emergence of the axillary artery in the fossa axillaris as close as possible to the lateral border of pectoralis major muscle .

MOTOR RESPONSE

Distal motor response (flexion or extension of the wrist or fingers) is the desired response . Position of the needle is adjusted to maintain the same motor response with a current less than 0. 5mA. After negative aspiration for blood, the 30 – 40 ml volume of local anesthetic is slowly injected aspirating for blood every 5 ml .

Distribution of anesthesia

A typical distribution of anesthesia after an infraclavicular brachial plexus block includes the hand, wrist, forearm, elbow, and distal arm. The skin of the axilla and proximal medial arm is not anesthetized (intercostobrachial and median cutaneous brachii nerves).

Local Anesthetic infiltration :

The skin insertion site is infiltrated with Local Anesthetic using 25 G needle . Local anesthetic should also be infiltrated into pectoralis muscle to decrease discomfort during needle insertion and soreness after procedure.

Complications

- Hematoma
- Toxicity
- Nerve injury
- Pneumothorax

Interpretation of responses to nerve stimulation

Stimulation	Motor Response	Explanation	Corrective Action
Pectoralis muscle - direct muscle stimulation	Arm adduction	Too shallow a placement of the needle	Continue advancing the needle
Latissimus dorsi	Arm adduction	Too deep a placement of the needle	Withdraw the needle to skin level and reinsert in another direction (superior/inferior)
Axillary nerve	Deltoid muscle	Needle placed too inferiorly	Withdraw the needle to skin level and reinsert with a superior orientation
Musculocutaneous nerve	Biceps twitch	Needle placed too superiorly	Withdraw the needle to skin level and reinsert with a light caudal orientation

PHYSIOLOGY OF NERVE CONDUCTION AND BLOCKADE [5,7]

ANATOMY OF THE PERIPHERAL NERVE

Each peripheral nerve axon possesses its own cell membrane, the axolemma. Most large motor and sensory fibers are enclosed in many layers of myelin, which consists of plasma membranes of specialized Schwann cells that wrap themselves around the axon during axonal outgrowth.

Myelin greatly increases the speed of nerve conduction by insulating the axolemma from the surrounding conducting salt medium and forcing the action current to flow through the axoplasm to the nodes of Ranvier, which are periodic interruptions in the myelin sheath where action currents are regenerated . The Na^+ channels that serve impulse generation and propagation are highly concentrated at the nodes of Ranvier of myelinated fibers, but they are distributed all along the axon of non myelinated fibers .

A typical peripheral nerve consists of several axon bundles, or fascicles. Each fiber has its own connective tissue covering, the endoneurium. Each fascicle of axons is encased by a second connective tissue layer, the epithelial-like perineurium, and the entire nerve is wrapped in a loose outer sheath called the epineurium . To reach its site of action (the nerve axon), a local anesthetic molecule must traverse four or five layers of connective tissue or lipid membranous barriers or both.

Physiology of Impulse Conduction

Like other cells, neurons maintain a resting membrane potential by active transport and passive diffusion of ions. An electrogenic sodium–potassium pump (Na^+-K^+-ATPase) couples the transport of three sodium ions out of the cell for every two potassium ions it moves into the cell. This creates a concentration gradient that favors the extracellular diffusion of potassium and the intracellular diffusion of sodium.

The cell membrane is normally much more permeable to potassium than to sodium, however, so a relative excess of negatively charged ions (anions) accumulate intracellularly. This accounts for the negative resting potential difference (–70 mV polarization).

Unlike most other types of tissue, neurons have membrane-bound, voltage-gated sodium and potassium channels that produce membrane depolarization following chemical, mechanical, or electrical stimuli. If the depolarization exceeds a threshold level (about –55 mV), voltage-gated sodium channels are activated, allowing a sudden and spontaneous influx of sodium ions and generating an action potential that is normally conducted as is an impulse along the nerve axon.

The increase in sodium permeability causes a relative excess of positively charged ions (cations) intracellularly, resulting in a reversal of membrane

potential to +35 mV. However, a subsequent rapid drop in sodium permeability (caused by inactivation of voltage-gated sodium channels) along with a transient increase in potassium conductance through voltage-gated potassium channels (allowing more potassium to exit the cell) return the membrane to its resting potential. Baseline concentration gradients are eventually reestablished by the sodium–potassium pump.

Theories of Local Anesthetic Action

Sodium channels are membrane-bound proteins that are composed of one large *alpha* subunit, through which sodium ions pass, and one or two smaller *beta* subunits. Voltage-gated sodium channels exist in three states—resting, activated (open), and inactivated .

Most local anesthetics bind the *alpha* -subunit and block voltage-gated sodium channels from inside the cell, preventing subsequent channel activation and interfering with the large transient sodium influx associated with membrane depolarization. This does not alter the resting membrane potential, but with increasing concentrations of local anesthetic, impulse conduction slows, the rate of rise and the magnitude of the action potential decrease, and the threshold for excitation is raised progressively until an action potential can no longer be generated and impulse propagation is abolished.

Local anesthetics have a much greater affinity for the channel in the activated and inactivated state than in the resting state. As a result, local anesthetic action is both voltage and time dependent, their effect is greatest when nerve fibers are firing rapidly.

Local anesthetics may also block calcium and potassium channels and *N*-methyl-D-aspartate (NMDA) receptors to varying degrees. Differences in these additional actions may be responsible for clinically observed differences between agents. Conversely, other classes of drugs, most notably tricyclic antidepressants (amitriptyline), meperidine, volatile anesthetics, and ketamine also have sodium channel-blocking properties.

Basics of nerve stimulation[4]

The first description of electrical stimulation to locate the brachial plexus was recorded by Perthes in 1912. However, the acceptance of this method to aid in performance of peripheral nerve blocks was not realized until the 1960s. Greenblatt and Denson have demonstrated that motor nerves can be stimulated without eliciting pain.

It is important to realize that nerve stimulators are not used as a replacement for the sound knowledge of anatomy, but to help to position the needle in closer proximity to the nerve without a required contact with the nerve (paresthesia) and with less discomfort to the patient.

The ability to stimulate a nerve depends on the intensity of the current applied and the duration of the current. In mixed nerves it is possible to stimulate the motor component without eliciting pain by limiting the current intensity and duration. To stimulate motor fibers, a current of shorter duration (0.05 to 0.2 ms) is typically used.

The use of shorter pulse duration increases the likelihood of an increased proximity between the nerve fibers and the unshielded tip of the needle, but makes the localization of the nerve more challenging. Consequently, the nerve stimulator is usually set up with a current of 1 to 1.5 mA and a pulse duration of 0.1 to 0.3 ms. The intensity of the current is decreased along with the pulse duration to adjust the position of the needle

An important principle of peripheral nerve stimulation is the preferential “cathodal stimulation.” In other words, when the nerve is stimulated by an electrode, significantly less current is required to obtain a response to a nerve stimulation when the cathode (negative) rather than the anode (positive) is adjacent to the nerve.

Another fundamental principle is that the current intensity required to stimulate the nerve is in relationship with the distance of the needle from the nerve. The relationship between the current and the distance from the nerve is governed by Coulomb’s law:

$$E = K(Q/r^2)$$

E - current required to stimulate *r* - needle–nerve distance

This principle is used to estimate needle–nerve distance by employing a stimulus of known intensity and pulse duration. It should be noted that this relationship is not linear, which means that as the needle–nerve distance increases, a current of substantially greater intensity is required to stimulate the nerve.

NEEDLES

Insulated beveled needles are commonly used in combination with a nerve stimulator for single nerve blocks . The negative electrode of the nerve stimulator is connected to the insulated needle while the positive electrode of the nerve stimulator is connected to an electrocardiogram electrode serving as a ground electrode. In addition, for the placement of perineural catheters for continuous nerve block techniques the use of an insulated introducer Tuohy needle is frequently preferred. Although the use of a stimulating stylet for the placement of a perineural catheter was described as early as 1951, the use of a stimulating catheter has only recently been introduced clinically.

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CLINICAL PHARMACOLOGY[5-12]

LOCAL ANESTHETICS

The typical local anesthetic molecule contains a tertiary amine attached to a substituted aromatic ring by an intermediate chain. The tertiary amine is a base (proton acceptor). The chain almost always contains either an ester or amide linkage, local anesthetics may therefore be classified as aminoester or aminoamide compounds. The aromatic ring system gives a lipophilic character to its portion of the molecule, whereas the tertiary amine end is relatively hydrophilic.

PHARMACOLOGY OF BUPIVACAINE

Bupivacaine is an aminoacyl amide synthetic local anaesthetic . It is produced for clinical use as a racemic mixture of the enantiomer containing equal proportions of the S and R forms.

PHYSIOCHEMICAL PROPERTIES

Bupivacaine has a butyl group on the piperidine nitrogen atom of the molecule. It is a long acting local anaesthetic drug with high anaesthetic potency. It crosses the placenta and the blood brain barrier.

On the cardiovascular system, the effect of bupivacaine is dose related. It depresses the automaticity of the heart and myocardial contractility. Bupivacaine depresses Vmax considerably more than lignocaine and results in slowed conduction of the cardiac action potential which is manifested as the prolongation of the PR and QR intervals on the electrocardiogram. This results in reentrant phenomenon and ventricular arrhythmias. The Na^+ channels are blocked in a fast - in slow-out manner which causes difficulty in resuscitation when the ventricular fibrillation has occurred.The CC/CNS dose ratio for Bupivacaine was 2.0.

PHARMACOKINETICS

Volume of distribution at steady state	1.02 L/kg
Elimination half life	3.5 hours
Clearance	0.41 lt/kg/hr

Metabolism is in Liver by dealkylation to Pipecolyloxilidine . Excretion is by the kidney as unchanged drug and the rest as metabolites.

DRUG DOSAGE:

Toxic dose is up to 3 mg/kg with or with out epinephrine.

PHARMACOLOGY OF LIGNOCAINE

Lignocaine is the most commonly used local anesthetic agent. It is a tertiary amide and first used by Gordh in 1948.

Properties

It is a tertiary amine which is an amide derivative of Diethyl aminoacetic acid . It is less toxic than Bupivacaine .

The clearance is reduced in presence of Propranolol. Like prilocaine, the metabolism can give rise to methhemoglobin. It can be used to supplement analgesia in General anesthesia and because of its membrane stabilizing effect on cardiac tissue it is used in treatment of ventricular arrhythmia. The CC/CNS dose ratio for Lignocaine is 7.1.

PHARMACOKINETICS

Volume of distribution at steady state	1.3 l/KG
Elimination half life	1.6 hour
Clearance	0.85 lt/kg/hr

The principal pathway of metabolism of lidocaine is oxidative dealkylation in liver to monoethylglycinexylidide , followed by hydrolysis of this to xylidide , 75 % of this metabolite is excrerted in urine.

Dosage :

Toxic Dose – 3 mg / Kg . & 7 mg /kg with adrenaline

For ventricular arrythmias – bolus of 1 – 1.5 mg /kg followed by infusion of 1 – 4 mg / min

GLYCOPYRRONIUM

Glycopyrronium is a quaternary ammonium compound that does not readily cross the placenta or blood brain barrier and so does not cause central anticholinergic effects. Acts by competitive antagonism of acetylcholine at peripheral muscarinic receptors .

Action

1. Reduces tone of LES.
2. Suppresses gastric secretion better than atropine .
3. Effective in preventing bradycardia after suxamethonium .
4. More potent and long lasting than atropine in drying salivary secretion .
5. Antagonizes peripheral muscarinic effects of anticholine esterases

Dosage :

Premedication : 0.2 – 0.4 mg for adults , 4 – 8 mic.g/kg for children

For bradycardia : 0.2 mg for adult , 4 mic.g / kg for children

MIDAZOLAM

Midazolam exists in two dynamic isomers – open diazepine ring form is water soluble , but the closed – ring form is not . It is presented as a solution at pH 4 , favouring the ionized , open ring isomer . On IV injection , a rise in pH alters the equilibrium that favours ring closure and passage across the blood brain barrier

Mechanism of Action

Full agonist at Benzodiazepine site on the gamma subunit of the $GABA_A$ Receptor complex . It augments hyperpolarisation by increasing the frequency of channel opening . Action reversed by antagonist Flumazenil .

Pharmacokinetics

Hepatic metabolism is by hydroxylation by CYP 3A4 & CYP 2A19 isoforms of Cytochrome P450.

Protien bound	98 %
Clearance	7 ml/kg/min
Volume of distribution	1L/Kg
Elimination half time	2 hours
Active metabolites	1 - & 4- Hydroxy midazolam

Dosage

Induction – 0.15 – 0.3 mg / kg

Sedation – 2 – 5 mic.g/kg/min

Premedication – Intranasal -0.2 mg/kg ,oral 0.5 mg/kg ,rectal 0.3 - 0.5 mg/ kg , Intramuscular – 0.07 -0.08 mg/kg .

FENTANYL

Fentanyl - μ - opioid receptor analog – is the most frequently used opioid in clinical practice. The clinical potency of fentanyl is 50 – 100 times that of morphine and there is direct relationship between plasma concentration and analgesia.

Pharmacokinetics

Clearence of fentanyl is primarily by hepatic metabolism .N – dealkylation to Norfentanyl and hydroxylation of both parent and metabolite

Protein binding	84 %
Clearance	1530 ml/min
Volume of Distribution	334 L
Elimination half time	3.1 – 6.6 hours

Dosage :

Premedication – 1 – 2 mic . g /kg IV

Analgesia in GA – 0.5 – 2.5 mic.g / kg IV followed by 2 – 10 mic.g/kg /hr infusion.

Cardiac Surgery – 50 – 150 mic.g/kg IV as sole anesthetic .

REVIEW OF LITERATURE[13-24]

Jean Desroches et al ., did a observational study on Infraclavicular Brachial Plexus by coracoid approach in 150 patients . He used a point marked 2 cm medial and 2 cm caudal to coracoid process as point of entry . Neurostimulation was used and 40 ml of Mepivacaine 1.5% with adrenaline was injected . He concluded that Coracoid approach provides an extensive sensory distribution with an excellent tourniquet tolerance and highly consistent brachial plexus anesthesia for upper extremity surgery .

Alain Borgeat et al ., described a modified approach of the Raj technique based on the identification of the anterior acromial process, jugular notch, and emergence of the axillary artery within the axillary fossa, with the arm abducted to 90° and elevated by approximately 30° injecting 40 to 50 mL of ropivacaine 0.6% in 150 patients . They concluded that the modified approach of the Raj technique for infraclavicular block is very effective when a distal nerve stimulator response is obtained with a small complication rate and a high degree of patient satisfaction.

Oivind Klaastad et al examined, the anatomical basis of Raj's infraclavicular method for brachial plexus blockade in volunteers using a magnetic resonance scanner . Concluded that a modification of the method is necessary to guide the needle closer to the cords and further away from the pleura and the axillary vein. A more lateral needle insertion seems beneficial.

Jonathan D. Bocquet et al determined a simple, reliable and reproducible reference point by means of magnetic resonance imaging (MRI), using the anterior extremity of the coracoid process. The optimal puncture point for a needle introduced strictly in an anterio-posterior direction in a supine, alert patient is located 2 cm within and 2.5 cm below the coracoid process. The injection point is located an average of 5 cm from the skin (mean 5.02 cm, with a standard deviation of 1.03).

Vincent Minville et al described a modified coracoid approach to the infraclavicular brachial plexus using a double-stimulation technique The needle was inserted in the direction of the top of the axillary fossa with an angle of 45 degrees. Using nerve stimulation, the musculocutaneous nerve was identified first and blocked with 10 mL of 1.5% lidocaine with 1:400,000 epinephrine. The needle was then

withdrawn and redirected posteriorly and medially. The radial, ulnar, or median nerve was then blocked. Modified infraclavicular brachial plexus block using a double-stimulation technique was easy to perform, had frequent success.

Oivind Klaastad, MD et al described a Novel Lateral and Sagittal Technique, developed by Magnetic Resonance Imaging Studies . The point of needle insertion is the intersection between the clavicle and the coracoid process. The needle is advanced 0°–30° posterior, always strictly in the sagittal plane next to the coracoid process while abutting the antero-inferior edge of the clavicle . Plexus was contacted within a needle depth of 6.5 cm.

Jack L. Wilson et al reviewed the magnetic resonance images of the brachial plexus from 20 male and 20 female patients. Located a point approximately 2 cm caudad to the coracoid process on the skin of the anterior chest wall. From this point, simulated needle directed to contact the neurovascular bundle and measured depth. The mean distance from the skin to the anterior wall of the axillary artery was 4.24 cm in men and 4.01 cm in women

Vincent Minville et al compared the success of the infraclavicular brachial plexus block using double-stimulation in regard to the second nerve response elicited with neurostimulation. The musculocutaneous nerve was initially blocked and the groups were then evaluated according to the second nerve located. The success rate was 96% for the radial response group, 89% for the median response group and 90% for the ulnar response group .

Harish Lecamwasam et al hypothesized that posterior cord stimulation would be associated with a greater likelihood of InfraClavicular block success. Compared with stimulation of either the lateral or medial cord, stimulation of the posterior cord was associated with rapid onset of motor block in significantly more nerves, as well as a decreased likelihood of block failure. A low failure rate was also predicted by stimulation of more than one cord simultaneously.

Rodríguez J et al compared multiple injection and single posterior cord injection techniques for performing infraclavicular coracoid block . :\ Seventy patients undergoing surgery at or below the elbow were randomly assigned to receive an ICB after the elicitation of either a single radial nerve-type response (Radial group) or of two different main nerve-type responses of the upper limb, except for the radial nerve (Dual group). He concluded that injection of a local

anesthetic after a single stimulation of the radial nerve fibers produced more extensive anesthesia than using a dual stimulation technique .

Gurkan Y et al compared nerve stimulation versus ultrasound-guided lateral sagittal infraclavicular block in patients scheduled for hand, wrist and forearm surgery. In nerve stimulation group a needle was inserted into a sagittal plane, 20 degrees dorsally, until muscle twitches were observed in synchrony with the stimulation. In the USG group, the block was performed using the same puncture site but under ultrasonic guidance. The final position of the needle was verified with the use of a nerve stimulator. The block success rate was high and comparable in both groups. There was a trend toward improved block quality in the US group, although not significant.

Li PY et al explored the difference in the efficacy of infraclavicular brachial plexus block by stimulating different cords of the infraclavicular brachial plexus. 70 patients scheduled for elective surgical procedures below elbow underwent infraclavicular brachial plexus block with the Wilson's approach guided by nerve stimulator, to simulate the lateral cord (n = 32) or posterior cord (n = 38).He concluded that stimulating the posterior cord guided by nerve stimulator increases the efficacy of infraclavicular brachial plexus block compared with stimulating the lateral cord.

Jaime Rodriguez et al sought to determine the number of injections needed to provide a reasonably complete anesthesia of the upper limb with this approach. Seventy-five patients were randomly assigned to receive a coracoid block guided by nerve stimulator with 42 mL of 1.5% mepivacaine with a single-injection (Group 1), dual-injection(Group 2), or triple-injection (Group 3) technique. No search for a specific motor response was performed in any group. He concluded that dual and triple injection of local anesthetic guided by nerve stimulator increases the efficacy of coracoid block when compared with a single-injection technique.

Hadzic A et al compared infraclavicular nerve block versus general anesthesia for hand and wrist day-case surgeries . 52 patients were randomly assigned to receive either an Infraclavicular block with 3% 2-chloroprocaine with epinephrine 1:3,00,000 followed by propofol sedation or GA- propofol induction, followed by laryngeal mask airway insertion and desflurane for maintenance and 0.25% bupivacaine for wound infiltration. Infraclavicular brachial plexus block with a short-acting local anesthetic was associated with time-efficient anesthesia, faster recovery, fewer adverse events, better analgesia, and greater patient acceptance than GA followed by wound infiltration with a local anesthetic.

MATERIALS AND METHODOLOGY

After obtaining Ethical committee clearance , study was conducted in Madras medical college (Orthopedic operation theatre & Emergency operation theatre) from March 2009 to August 2009 .

Patient selection

Study population included adult patients (ASA I & II), age group 18 – 70 years , admitted for elective & emergency surgical procedures in upper limb.

Study Group

- Group I : Twenty five numbers
- Group II : Twenty five numbers

Elective adult surgical patient posted for surgery from elbow to hand

Exclusion criteria

Previous neurological deficit

Psyciatric illness

Neuropathy or drug abuse

Post pneumonectomy

Bilateral surgery

Pregnant women

Patients were all pre operatively evaluated, clinically examined and investigated prior to Surgery . Procedures were explained and written consent obtained .The procedure were carried out in preparation room or in the theatre where facilities for resuscitation are available.

Equipment :

- Sterile tray,towel,cup &gloves
- 2 nos 10 ml syringe
- Sponge holding forceps
- Savlon / betadine solution
- Nerve stimulator Stimuplex Dig RC – B. Braun Melsengen AG, Germany
- Needle – 10 cm – Stimuplex 21 G , B. Braun Melsengen AG , Germany

Drugs :

20 cc Lignocaine 2% with adrenaline 1 : 2,00,000 and 20 cc Bupivacaine 0.5 %

Monitors :

All patient were monitored with NIBP (every 5 min) , continuous ECG monitoring and Pulse oximeter monitoring . Patients were monitored continuously both during performance of block and during surgery.

Procedure

1. Local anesthetic testing : 0.1 ml of 0.5 % lignocaine taken in tuberculin syringe . An intradermal wheal is raised in the forearm with a 26 G needle . After 5 min , the forearm was observed for any redness , itching , erythema or increase in size of swelling .
2. Patients shifted to operation theatre or preparation room and monitors were connected .
3. 18 G Intravenous line started on non operative hand .
4. All patients were premedicated intravenously with Inj. Glycopyrolate 0.2 mg + inj. Fentanyl 50 – 100 mic.g + inj. Midazolam 1 -2 mg.
5. After premedication all patients were supplementd with oxygen via face mask 6 – 8 L / min.

6. The side to be blocked disinfected with betatidine paint and draped with sterile towel .

7. With skin marker following points are marked.

Group I : (Modified Raj approach) clavicle full length marked, midpoint of clavicle , a point one cm below it (point of entry) and point of maximum pulsation of axillary artery are marked.

Group II : (Coracoid approach) Coracoid process and a point 2cm medial and caudal to the coracoid process (point of entry) marked.

8. The point of entry infilterated with 1 % lignocaine with adrenaline 2cc.

9. Positoning

Group I : head turned away from the side to be blocked , arm to be blocked being abducted by 90 ° and elevated by 30 °.

Group II : head turned away from the side to be blocked , arm to be blocked laid in neutral position , along the body.

10. The positive pole of the nerve locator is placed along the course of the nerve with ECG lead and negative pole attached to the single shot 21 G stimulating needle of length 10 cm . At that

point operating room stop clock started .

11. In group I patients , the needle inserted thorough 1 cm below

Mid point of clavicle and directed towards maximum pulsation

In group II patients needle inserted through 2cm caudal and medial to coracoid process and directed perpendicular to skin.

12. To start with intensity of current was kept at 2.0 mA and an Frequency 2 hz . Distal motor response was sought like flexion / extension of the wrist and fingers .

13. Once desired response obtained , current intensity reduced in a graded manner to obtain the same response at a intensity of less than 0.5 mA.

14. After obtaining optimal response , drug injected slowly , aspirating for blood for every 4-5 ml.

15. Appearance of sensory block (cold & pin prick) and motor block evaluated every two min for first ten minutes and thereafter every five min for next twenty min .

16. Sensory block checked in following five nerve territories

Musculocutaneous	- Lateral side of forearm
Radial	- Dorsum of hand over 2nd MCP joint

Median	-	Thenar eminence
Ulnar	-	Little finger
Medial Cut. N. of forearm	-	Medial side of fore arm

17. Sensory and motor block assessed by Hollmen's scale .

18. Successful block is defined as an analgesia in all five nerves distal to elbow within thirty minutes . When one or two nerves left unblocked, they supplemented with axillary or elbow block . If more than two nerves left unblocked , general anesthesia was instituted .

19. Patients were monitored thorough out the procedure and during surgery

20. Duration of block assessed as time interval between administration of local anesthetic and the first demand for analgesics

Hollmen's Scale :

Sensory Blockade

1 / 0 – Normal sensation of Pinprick.

2 / + - Pin prick felt as sharp pointed but weaker compared with the same area in other extremity.

3 / ++ - Pin prick recognized as touch with the blunt object.

4 / +++ - No Perception of Touch.

Motor Blockade

1 / 0 - Normal muscle function.

2 / + - Slight depression in muscle function as compared with Preanesthetic power .

3 / ++ - Very weak muscular action persisting in muscle.

4 / +++ - Complete block.

OBSERVATION AND RESULTS

The patients included in this study were divided into two groups consisting of 25 patients each.

Group R (n=25) received Infraclavicular block by Modified Raj approach.

Group C (n=20) received Infraclavicular block by Coracoid approach.

Age :

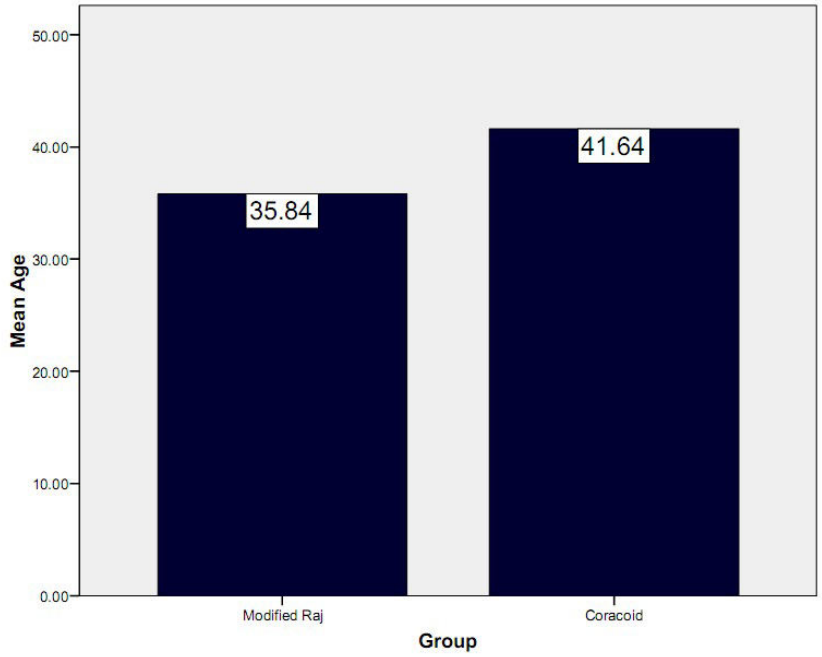
Group	N	Mean	Std.deviation	Std.Error
R	25	35.84	10.34	2.07
C	25	41.64	13.43	2.68

	df	F	p value
Chi square test	48	2.93	0.094

The two groups were similar with respect to age distribution and difference was statistically insignificant .

Sex :

Group	Male (%)	Female (%)	Total
R	12 (48 %)	13 (52 %)	25
C	15(60 %)	10 (40 %)	25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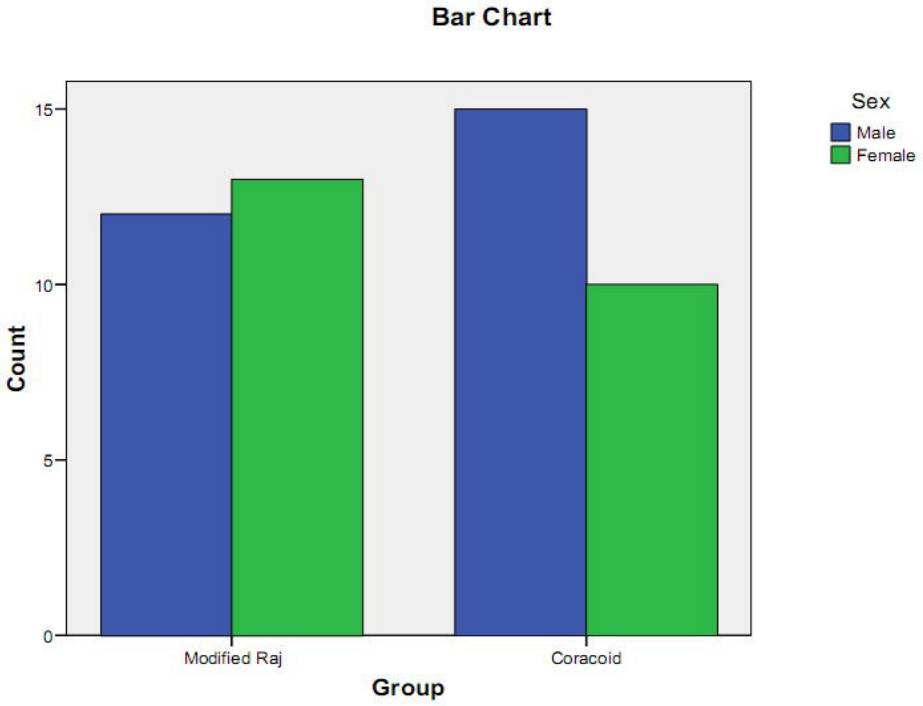
0.00
Mean Age
35.84
41.64
Modified Raj
Coracoid
Group


Bar Chart
15
10
5
0
Count
Modified Raj
Coracoid
Group
Sex
Male
Female

	Value	df	p value
Pearson Chi-square	0.725	1	0.395

With regard to Sex distribution two groups are comparable and difference is statistically insignificant .

Weight:

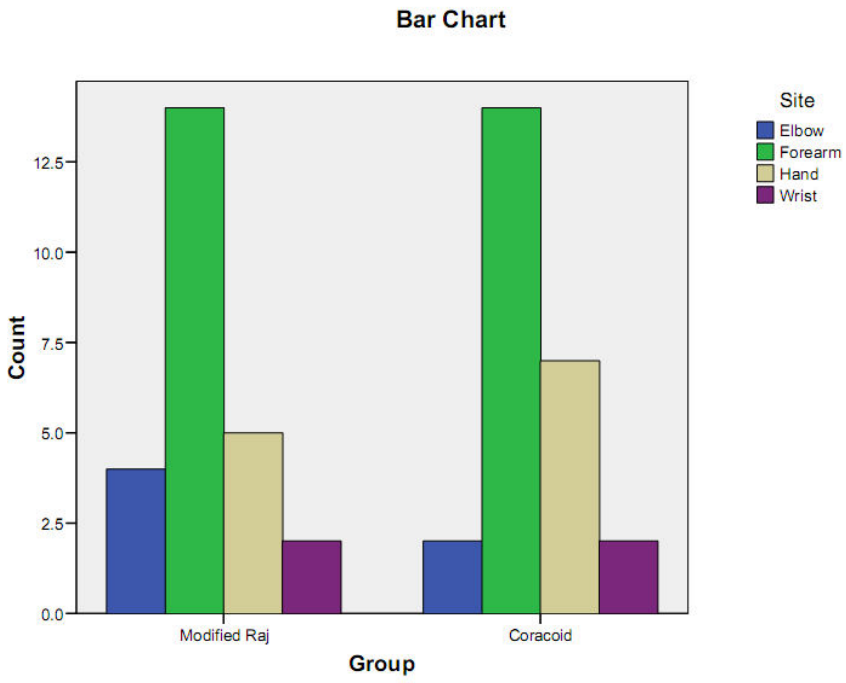
Group	N	Mean	Std.deviation	Std.Error
R	25	65.52	5.04	1.01
C	25	63.88	3.94	0.79

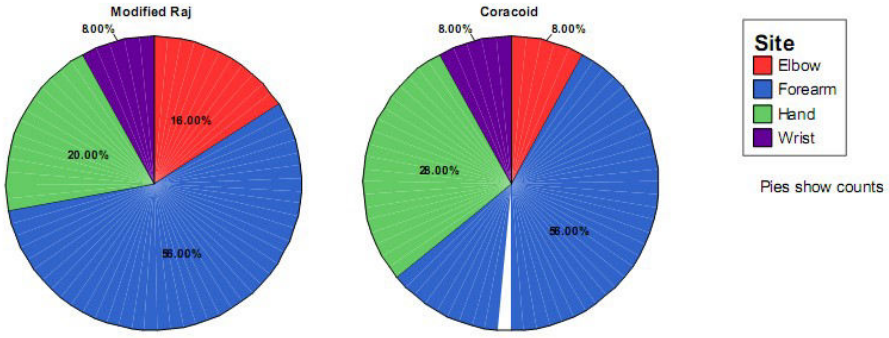
	df	F	p value
Chi square test	48	1.642	0.206

The two groups are comparable with respect to weight and difference is statistically insignificant .

Site of surgery :

Group	Variable	Elbow	Forearm	Hand	Wrist
R	No.	4	14	5	2
	% within group	16%	56%	20%	8%
C	No.	2	14	7	2
	% within group	8%	56%	28%	8%


Bar Chart
Site
Elbow
Forearm
Hand
Wrist
Count
12.5
10.0
7.5
5.0
2.5
0.0
Modified Raj
Coracoid
Group


Modified Raj
8.00%
16.00%
20.00%
56.00%
Coracoid
8.00%
8.00%
28.00%
56.00%
Site
Elbow
Forearm
Hand
Wrist
Pies show counts

	Value	df	p value
Pearson Chi-square	1.000	3	0.801
Likelihood ratio	1.014	3	0.798

The two groups are well matched for the site of surgical procedure suggesting Intra operative anesthetic need were similar .

Depth :

Group	N	Mean	Std.deviation	Std.Error
R	25	694.40	76.11	15.22
C	25	575.20	51.33	10.27

	df	F	p value
Chi square test	48	42.154	0.002

The depth at which Brachial plexus reached by both approaches were of statistically significant difference . In R group it was reached at 6.94 cm and in C group it was 5.75 cm in average .

No. of attempts:

Group	N	Mean	Std.deviation	Std.Error
R	25	1.80	0.58	0.12
C	25	1.56	0.65	0.13

	df	F	p value
Chi square test	48	1.903	0.174

In view of no. of attempts both groups were comparable with a mean 0f 1.5 & 1.8 . No statistically significant difference

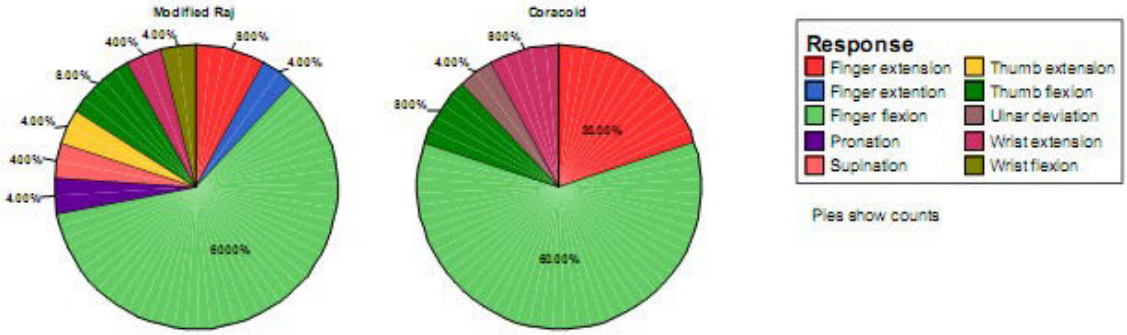
Response obtained :

Response	R		C	
	No.	% within group	No.	% within group
Finger flexion	15	60%	15	60%
Finger extension	3	12%	5	20%
Wrist flexion	1	4%	-	-
Wrist extension	1	4%	2	8%
Thumb flexion	2	8%	2	8%
Thumb extension	1	4%	-	-
Ulnar deviation	-	-	1	4%
Pronation	1	4%	-	-
Supination	1	4%	-	-

In both groups the response obtained was predominantly Finger flexion followed by Finger extension .

Time Taken :

Group	N	Mean	Std.deviation	Std.Error
R	25	6.44	1.92	0.38
C	25	4.76	1.96	0.39


Modified Raj
8.00%
4.00%
60.00%
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4.00%
8.00%
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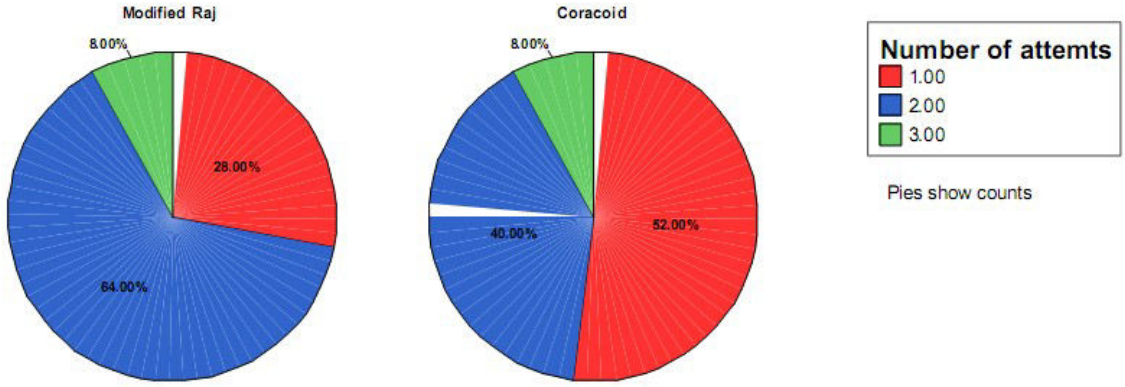
4.00%
Coracoid
8.00%
4.00%
8.00%
60.00%
Response
Finger extension
Finger extention
Finger flexion
Pronation
Supination
Thumb extension
Thumb flexion
Ulnar deviation
Wrist extension
Wrist flexion
Pies show counts


Modified Raj
8.00%
28.00%
64.00%
Coracoid
8.00%
52.00%
40.00%
Number of attemts
1.00
2.00
3.00
Pies show counts

	df	F	P value
Chi square test	48	9.371	0.004

The time taken to perform block took a mean time of 6.44 min in R group and 4.74 min in C group . The difference is statistically significant

Problem :

Group	Arterial Puncture	
	No.	% within group
R	2	8%
C	-	-

In Raj group alone 2 cases of arterial puncture encountered (8 %).

Success Rate :

Group	Success		Failure	
	No	% within group	No.	% within group
R	23	92%	2	8%
C	24	96%	1	4%

Block was considered failure in two patients among R group and in one patient in C group .

Sparing of Nerves:

Group	Musculocutaneous	Median	Radial	Ulnar	M.C.N Forearm
R	-	-	1(4%)	1(4%)	-
C	-	-	1(4%)	-	-

M.C.N. Forearm – Medial Cutaneous Nerve of forearm

All three cases were supplemented with Axillary Block .

Sensory block onset

Group	N	Mean	Std.deviation	Std.Error
R	25	6.64	1.38	0.28
C	25	3.92	1.35	0.27

	df	F	p value
Chi square test	48	49.543	0.001

For the onset of sensory block it took an average of 6.64 min in R group and 3.92 min in C group . Onset was faster in C group

Sensory block complete :

Group	N	Mean	Std.deviation	Std.Error
R	25	12.00	1.63	0.33
C	25	8.56	1.96	0.39

	df	F	p value
Chi square test	48	45.467	0.00

The sensory block was complete in 12 min in R group and 8.56 min in C Group . Block was complete faster in C group.

Motor block onset

Group	N	Mean	Std.deviation	Std.Error
R	25	7.76	1.33	0.27
C	25	5.82	1.51	0.30

	df	F	p value
Chi square test	48	37.810	0.002

The motor block onset was faster in C Group (5.82 min) compared to R group (7.76) . The difference is statistically significant .

Motor block complete

Group	N	Mean	Std.deviation	Std.Error
R	25	13.84	1.62	0.32
C	25	10.52	2.18	0.44

	df	F	p value
Chi square test	48	37.238	o.002

The motor block was complete faster in C group 10.52 min than R group 13.84 min , which was statistically significant.

Tourniquet :

Group	Used In		Pain	
	No.	% within group	Yes	No
R	12	48%	-	12
C	13	52%	-	13

In both groups Tourniquet was used in half of the cases and all patients were comfortable with tourniquet

Duration

Group	N	Mean	Std.deviation	Std.Error
R	25	13.o6	2.01	0.40
C	25	9.64	2.21	0.44

	df	F	p value
Chi square test	48	32.65	.001

The block lasted longer in R group (13.64 hrs) compared to C group (9.64 hrs) . p value of o.oo1

Discussion [13 -24]

The Infraclavicular block has been used extensively for upper extremity procedures and has been proved in many studies . Success rate are high when block performed with aid of Nerve stimulator or USG guidance .Gurkan Y et al compared nerve stimulation versus ultrasound-guided lateral sagittal infraclavicular block and showed that the block success rate was high and comparable in both groups.

Basis

Desroches et al proved that Infraclavicular Block shows consistent success rate by Coracoid approach described by Wilson et al . Borgeat et al demonstrated high success rate with Modified Raj approach of Infraclavicular block .

1. Modified Raj Approach by Borgeat et al – Group R
2. Coracoid approach by Wilson et al – Group C

Were selected as the approaches for the study .

Study Group

In the study 50 Patients were selected and divided in to two groups for Modified Raj approach and Coracoid approach . The groups were comparable with respect to Age ,Sex and Weight . The difference were

statistically insignificant (p value > 0.05). So, the difference proved in other variables have least possibility of occurring by chance .

Volume of Drug :

Borgeat et al used 40ml of 0.6% Ropivacaine for Infraclavicular Block . Desroches et al used 40 ml of 1.5 % Mepivacaine with adrenaline 5 mic.g/ml . So volume of 40 ml was selected for the study .Vincent et al used 20ml of Lidocaine 2 % containing 1:200,000 epinephrine and 20 ml of Bupivacaine 0.5 % for USG guided Supraclavicular Block. Since the above Local anesthetics are available in our Institution , the above combination was used for the study

Surgical Procedure

The study group included adult surgical patient posted for upper limb surgery (both emergency and elective surgical procedures) involving elbow , hand , wrist and fingers . Both groups were comparable with reference to the site of surgery . So , the anesthestic and analgesic need is comparable in both the groups . Hazdic et al in his study showed that Infraclavicular block is better than General anesthesia for hand and wrist day care surgeries .

Depth of the Plexus :

The Skin to plexus depth was measured in all cases . The depth at which Plexus reached was greater in R group -mean 6.94 cm compared to C group mean 5.75 cm . The difference is statistically significant . In coracoid approach needle is directed perpendicularly to skin but in Raj approach needle is directed laterally between 45 to 60 deg to the skin . So the distance travelled by the needle in Raj approach will be greater.

In the study of Jonathan D. Bocquet et al , the neurovascular bundle was located at a mean distance of 5.02 cm . In the study of Oivind Klaastad et al described a Novel Lateral and Sagittal Technique. Plexus as contacted within a needle depth of 6.5 cm. Jack L. Wilson, MD et al study showed that the mean distance from the skin to the anterior wall of the axillary artery was 4.24 cm (2.25-7.75 cm) in men and 4.01 cm (2.25-6.5 cm) in women .

No. of Attempts

In both the groups 90% of block were performed in first two attepmpts . Though in Group C most of the blocks (52%) was performed in first attempt and group R most were performed in second attempt (64 %) , the difference is statistically insignificant .

In the Borgeat et al study adequate response was obtained in first attempt in 39 % , in second attempt in 33% and third attempt in 19 % of cases .

Motor Response

In the study distal motor response was desired as end motor response in both groups . Finger flexion was obtained in majority of the cases (60 % in both R & C) followed by finger extension (12 % in R group & 20 % in C group) . In view of nerve being stimulated median nerve stimulation was obtained in majority of cases (70 % - both groups together) followed by Radial nerve (24 %) .

Desroches et al in his study shown that distal motor response had high success rate (near 100 %) than proximal motor response . Borgeat et al showed that successful block all five nerves was 97 % with distal motor response compared with success rate of 44% with proximal motor response.

Time to perform block

In Group C time taken to perform the block (4.74 min) shows statistically significant difference ($p<0.05$) compared to Group R (6.44 min) . The coracoid approach blocks were performed much faster

than with modified Raj approach . Desroches et al showed in his study with coracoid approach mean time to perform block was 5 +/- 2 min . Vincent Minville et al in his study had a procedure time of 5 +/- 3 min .

Problems

Arterial puncture was the only problem encountered during the performance of the blocks . Accidental arterial puncture occurred in two cases in Raj approach (8%) , none happened in Coracoid approach . Desroches et al reported only one case of pneumothorax in his study . Borgeat et al study had incidence of 2 % venous puncture and 0.6 % hematoma at puncture site .

Success Rate :

The success of block defined as the analgesia all five nerves below elbow occurred in 96 % (24 out of 25) of cases in Coracoid approach compared to 92 % (23 out of 25) of cases in Raj appraoach difference is minimal and statistically insignificant .

In Group C one case Radial Nerve sparing occurred in that Ulnar deviation was the response obtained. In group R one case of Radial Nerve and one case of Ulnar Nerve occurred , Supination and pronation were the response obtained respectively .This shows that Block success rate

was 100% when Median and Radial nerve stimulation were obtained like flexion and extension of fingers respectively .

Borgeat et al proved that best results were obtained when stimulation of median nerve with distal response obtained . Li PY et al and Harish Lecamwasam et al in their studies concluded that stimulating the posterior cord guided by nerve stimulator increases the efficacy of infraclavicular brachial plexus block. Rodríguez J et al in his study concluded that injection of a local anesthetic after a single stimulation of the radial nerve fibers produced more extensive anesthesia than using a dual stimulation technique .

Vincent Minville et al used double stimulation for infraclavicular block and showed a success rate of 92 %. And in another study he showed that having initially located and blocked the musculocutaneous nerve, subsequent injection on a radial response resulted in a slightly more reliable success rate than injection with an ulnar or median response.

Block Onset and duration

The mean time for sensory block onset & complete were 3.92 min and 8.56 min in Grop C compared to Group R 6.64 min and 12.00 min respectively . In both the values difference is statistically significant

(p value <0.05) . This shows that sensory block onset and completeness was faster in Group C than Group R .

The mean time for motor block onset & completeness were 5.28 min and 10.52 min in Group C compared to Group R 7.76 min and 13.84 min respectively . In both the values difference is statistically significant (p value <0.05) . This shows that Motor block onset and completeness was faster in Group C than Group R .

Tourniquet

Tourniquet was used in almost half of the patients during surgery in both groups , all patients tolerated Tourniquet well . No supplementation was given for tourniquet . Both Desroches et al and Borgeat et al showed that all patients tolerated tourniquet well and there was no need for supplement analgesics .

Duration

The duration of block was taken as the time patient asked for first rescue analgesia . The duration was longer in group R (13.6 hours) compared to group C (9.64 hours) . The difference is statistically significant . This shows that in group R block lasts longer than group C .

Vincent et al in his study used lignocaine with bupivacaine for supraclavicular block shown that blocked lasted for 11.4 +/- 4.2 hours. Borgeat et al in his study duration of block was around 14.2 +/- 3.3 hours , he used 0.6 % Ropivacaine .

SUMMARY

On comparing Modified Raj approach and Coracoid approach for Infraclavicular block in this study , it was found that

- The number of attempts taken to perform block and success rate are similar in both approaches.
- The time taken to perform block was shorter in Coracoid approach compared to Modified raj approach.
- Onset of Sensory and Motor block was faster in coracoid approach than modified Raj approach .
- The time taken to achieve complete sensory and motor block was earlier in Coracoid approach than Modified Raj approach .
- Duration of Block was significantly longer in Modified Raj approach compared to Coracoid Approach .
- Distal Motor response was desirable in both approaches . High success rate with Finger flexion.
- Tourniquet pain was tolerated well in Infraclavicular block by both approaches .

CONCLUSION

Both approaches have their own advantages

Coracoid Approach – less time needed to perform , faster onset .

Modified Raj Approach – longer duration .

In both approaches success rate was high , tourniquet was tolerated well and had less complication.

To Conclude , both approaches can be used for performing Infraclavicular block for upper limb surgeries from elbow to hand .

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PROFORMA

Patient name : Age : Sex: Weight :

IP No: Date: Ward:

Comorbid Condition : ASA : MPC :

Surgical Procedure : Duration :

Pre Block Parameter : PR- BP- SpO2- RR-

Anesthetic Procedure –

Concentration and Volume of Drug used :

Technique :

1. Position
2. Site of puncture:
3. Needle size
4. Depth of insertion:
5. No. of attempts
6. Response obtained : at:
7. Problem during procedure
8. Need for Supplementation / conversion
9. Sensory / motor sparing
10. Grading of block
11. Complications

	Time of injection	Time of onset	Intensity	Achieved at
Sensory Block				
Motor Block				

Intraoperative Hemodynamics ;

Time	HR	BP	SaO2
0 min			
1 min			
2 min			
3 min			
4 min			
5 min			
10 min			
15 min			
20 min			
25 min			
30 min			
35 min			
40 min			
45 min			
50 min			
55 min			
60 min			

Post op :

Duration of block : Sensory: Motor :

Hollmen's Scale :

Sensory Blockade :

1 / 0 – Normal sensation of Pinprick

2 / + - Pin prick felt as sharp pointed but weaker compared with the same Area in other extremity

3 / ++ - Pin prick recognized as touch with the blunt object

4 / +++ - No Perception of Touch

Motor

1 / 0 - Normal muscle function

2 / + - Slight depression in muscle function as compared with Preanesthetic power

3 / ++ - Very weak muscular action persisting in muscle

4 / +++ - Complete block

Time	Sensory block	Motor Block
5 min		
10min		
15 min		
20 min		
25 min		
30 min		
Post op		
6 hours		
12 hours		
24 hours		